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BREAK-EVEN POINT IN SUGAR-BEET PRODUCTION

Abstract

World sugar consumption has been recording a steady growth in the past 70 years and, according to all relevant estimates, it will continue to grow also in the next decade, which puts sugar in the category of the most significant foods and commodities in the world.

Of the total world sugar production, around 77% is derived from sugar cane and 23% from sugar beet. Brazil has been the world leader in sugar production for a long period of time, producing white sugar from sugar cane only, whereas the leader in the production of sugar derived from sugar beet is the EU-28.

When the Republic of Croatia joined the EU, the Croatian sugar industry became part of the single European sugar market, so the break-even point was used in the research to determine the competitiveness level of the Croatian sugar beet production.

Based on the expected selling price of sugar beet amounting to EUR 34 per ton of standard quality sugar beet, and using the break-even method, it was determined that the quantity required to cover total costs in sugar beet production in the Republic of Croatia amounts to 55.26 tons per hectare of payable sugar beet, standard quality, i.e. 8.84 tons of polarized sugar per hectare. As the average sugar beet production in the Republic of Croatia, expressed in the equivalent of polarized sugar, amounts to 7.8 tons per hectare, it is obvious that an average Croatian producer of sugar beet, without income from subsidies, operates at a loss.

Keywords: Break-even point, sugar, beet, cane

1. Introduction

The irrefutable truth is that in the modern world there is no developed society or developed economy without a developed agriculture. Therefore, it may well be concluded that the situation in agriculture is the best indicator of the overall situation in a society, particularly its abilities to efficiently utilise available resources and competitive advantages.

By observing Croatian agriculture and key indicators of production, import, export, and the development level of rural areas, unfortunately, a conclusion can be drawn that in the past twenty years the Republic of Croatia was unable to provide even the basic prerequisites (for example, formulating the agricultural strategy, establishing long-term land policy, irrigation, zoning, financing scheme, etc.) to use available resources. Despite huge resources invested in agricultural subsidies and preferential trade status with the European Union in the period 2005-2013, today we have mostly unorganised, non-competitive production and devastated rural areas. Such a situation in agriculture, of course, cannot

and must not be observed separately from the situation in the society as a whole, and certainly one should take into account war events (a great part of population left rural areas; direct war damages), as well as an overall lack of adequate monetary and fiscal policy.

The recent accession of the Republic of Croatia to the European Union resulted in the obligation of adapting the Croatian agricultural policy according to the Common Agricultural Policy of the European Union[1], so it will be extremely difficult to compensate for everything that we have failed to do in the past twenty years, particularly in the conditions of the open EU market. One of the more important CAP segments at the EU level is certainly the sugar market order[2] that represents a continuation of the sugar market order in the EU, in force since 1968.

A developed sugar industry has been present in the Republic of Croatia for more than a century. Having been through the transition and privatisation process and owing to special trade agreements with the European Union[3], in the period from 2006 to the present the Croatian sugar industry has recorded good business results and provided the leading position in the export balance of the Croatian food industry[4]. However, the decision to lift the production restrictions in the sugar sector, adopted at the EU-28 level and coming into effect in 2017, makes one wonder how this decision will affect Croatian sugar factories, what is the future of this industry and, consequently, of sugar beet production in the Republic of Croatia.

To answer these questions, the break-even point was applied to determine the required level of sugar beet production per hectare, at which revenue is equal to costs, i.e. the break-even point in sugar beet production in the Republic of Croatia. In addition, competitiveness of the Croatian sugar industry was compared with other EU-28 states. The data used as the default values were historical data on the achieved level of yield measured in tons of polarized sugar per hectare, projections of expected future prices of sugar beet in the EU-28[5], as well as real costs of sugar production of selected, representative sugar beet producers in the Republic of Croatia, who are successful sugar beet producers in terms of cost effectiveness.

2. Definition of the break-even model

Any business venture can produce a profit only when its total revenue exceeds its total costs. In the event that costs exceed revenue, the venture will generate a loss. A whole array of economic models is available for determining whether a venture or a product generates gain or loss. One of the simplest tools for assessment of economic feasibility of a venture or a product is the break-even analysis.

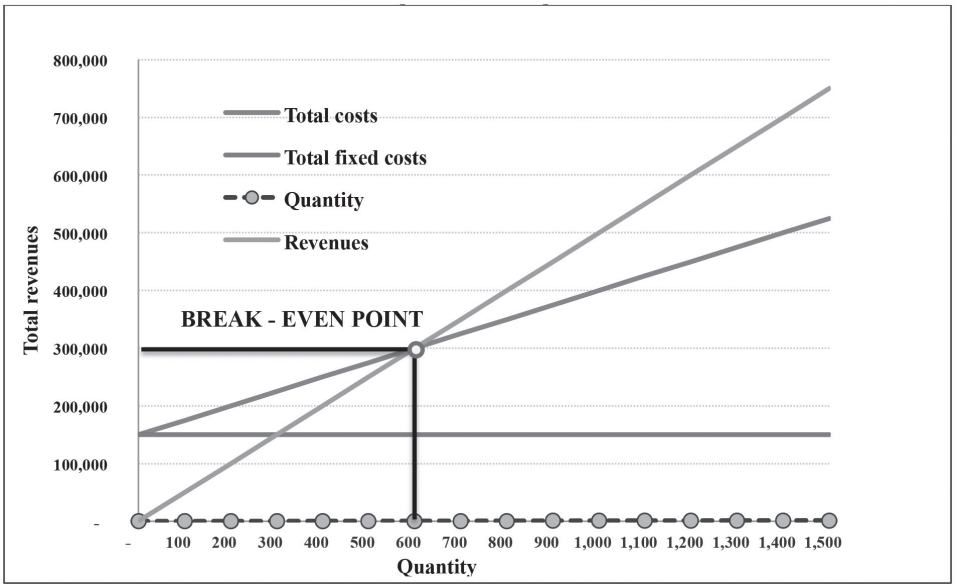
Although it is a fairly straightforward indicator, the break-even point is relatively underused in the available literature and research papers. The intention of this paper was to demonstrate the simplicity of use of this tool and to motivate other authors to employ this type of analysis in their research more frequently.

The break-even point is the level of business at which total revenues are equal to total costs. The term "break-event point" arises from the graphic interpretation of this model, because the break-event point is at the intersection of total revenues and total costs, thus reflecting the level of revenue and quantity of products required to reach the break-even point. Understandably, at this point, where total revenues and total costs become equal and intersect, a company or a product for which the break-even point is being determined generates neither loss nor gain.

The break-even point may be expressed in units of products (quantity) or revenue. Simply put, for a particular product it can be determined that the break-even point will be reached by selling, for example, 600 units of this product at an annual level. It can also be determined that, for example, total revenue amounting to 300,000 will provide the rentability threshold, i.e. at this revenue level the company's revenues and costs will be equal, thus the company will be operating at no profit or loss (Graph 1).

It is clear that any sale of the product above the quantity defined by the break-even point (in our example more than 600 units) will generate profit, whereas any sale below the break-even point will generate loss. The same applies to revenue: if revenue is higher than the amount determined by the break-even analysis (in our example more than 300,000), profit is generated, and if revenue is below the amount determined by the break-even point, loss is generated.

Graph 1 Break-even point



Source: Author

The method used to calculate the break-even point is quite simple, which is the key advantage of this model. However, the key disadvantage of this model is that it presumes a linear revenue growth, meaning that the company sells products at the same price and that it has the same sales structure and the product mix regardless of the sales volume and time dimension, as well as a linear change of total cost of the product regardless of the production volume.

3. Sugar production and consumption

Observed at the global level, sugar consumption has recorded significant growth in the past seventy years, from 24 million tons in 1940 to 163 million tons estimated for 2011. Asian countries, primarily India and China, account for the most significant part of the world sugar consumption, although in terms of per capita consumption, these are still the areas with the lowest sugar consumption.

According to current estimates, sugar production and consumption in the world is expected to grow by 1.9% per year in the period until 2023[6].

Consumption growth will be most pronounced in the areas where sugar consumption is below the global average, primarily in China and India, but also in Indonesia and Africa.

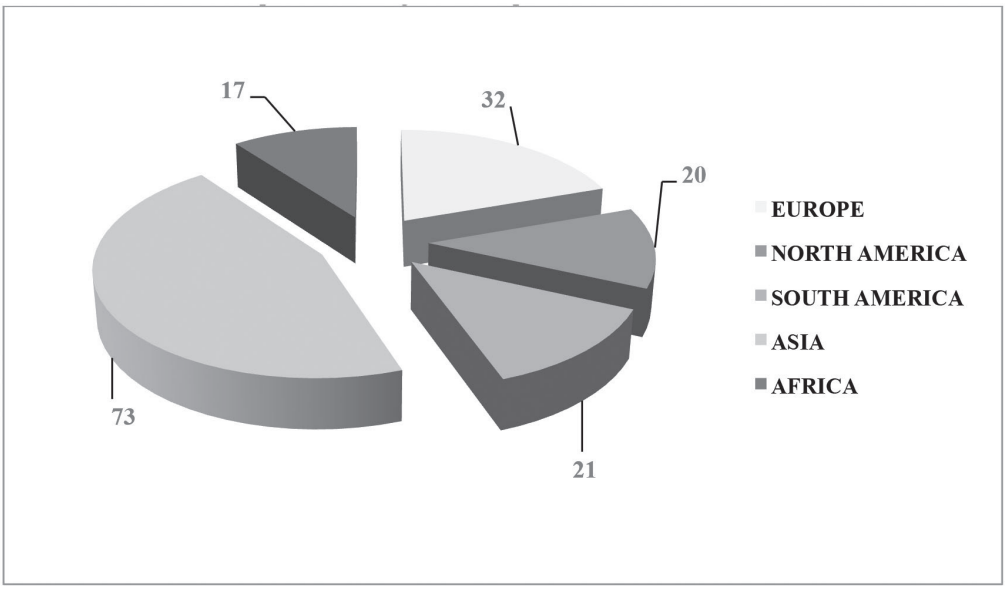
Regarding sugar production, today's sources are sugar cane and sugar beet. Depending primarily on climate conditions, 9 countries of the world produce sugar from both sugar cane and sugar beet, whereas sugar derived from sugar cane only is produced in 71 countries, and sugar derived from sugar beet only is produced in 43 countries of the world.

Observed at the global level, sugar cane is used as raw material for production of 77.1% of the total produced sugar (data for marketing year 2011/2012), and the remaining 22.9% of sugar is produced from sugar beet.

The world sugar production is dominated by Brazil, China, India, the EU and Thailand. In the marketing year 2013/2014 together they produced around 102 million tons of sugar, or 58.5% of the world sugar production.

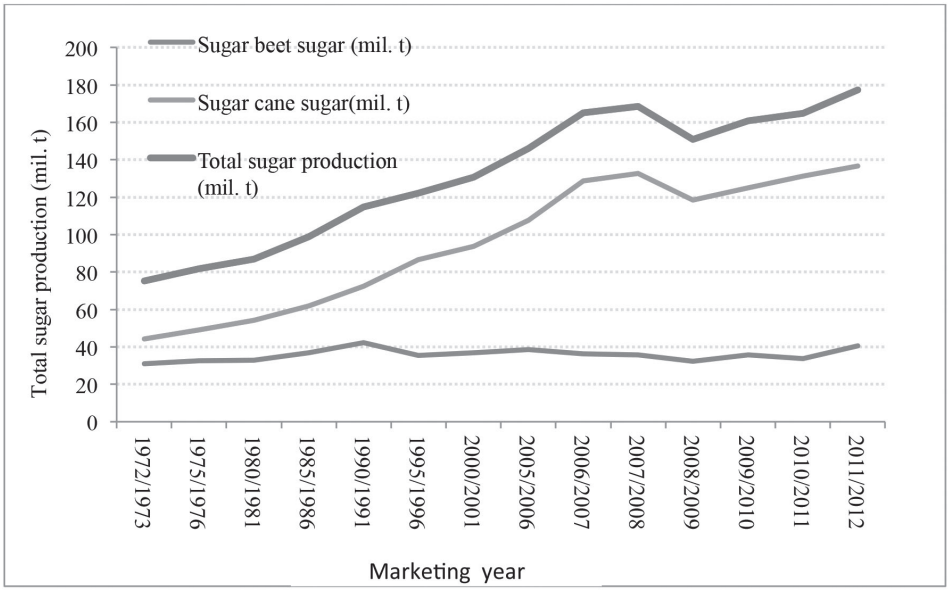
It is interesting to look at the sugar production and consumption balance by countries and regions (Table 1).

Graph 2 World sugar consumption in million tons – 2011



Source: Author

Graph 3 World sugar production 1972 – 2011



Source: Author

Table 1 Sugar production and consumption by country/region (000t) - 2013/2014

Country/Region	Production	Consumption	Importer (-)/ Exporter
Argentina	1,780	1,850	-70
Australia	4,400	1,218	**3,182**
Brazil	**37,800**	**11,260**	**26,540**
Canada	100	1,131	-1,031
China	**14,263**	16,500	**-2,237**
Colombia	2,300	1,565	735
Cuba	1,600	740	860
Dominican Republic	561	390	171
Egypt	2,013	2,870	-857
European Union-28	**16,010**	**18,300**	**-2,290**
Guatemala	2,852	764	**2,088**
India	**26,605**	**26,000**	605
Japan	750	2,154	-1,404
Mexico	6,383	4,543	**1,840**
Other Caribbean	190	425	-235
Other Central America	2,700	1,330	1,370
Other East Asia	65	2,382	**-2,317**
Other Europe	684	984	-300
Other Former Soviet Union	2,133	3,542	-1,409
Other Middle East	1,530	**8,588**	**-7,058**
Other North Africa	400	3,219	**-2,819**
Other Oceania	240	361	-121
Other South America	3,370	4,597	-1,227
Other South Asia	335	2,962	-2,627
Other Southeast Asia	4,165	**10,439**	**-6,274**
Other Sub-Saharan Africa	5,976	**10,017**	**-4,041**
Pakistan	5,215	4,450	765
Philippines	2,450	2,200	250
Russia	4,400	5,615	-1,215
Thailand	**11,333**	2,600	**8,733**
Turkey	2,300	2,320	-20
United States	**7,672**	**11,084**	-3,412
Others	2,435	1,895	540
World	**175,010**	**168,295**	**6,715**

Source: United States Department of Agriculture, Economic Research Service, World production, supply, and distribution, centrifugal sugar, According to: http://www.ers.usda.gov/data-products/sugar-and-sweeteners-yearbook-tables.aspx#25440/ (Accessed on: February 24, 2015)

According to Table 1, Brazil, Thailand, Australia, Guatemala and Mexico are major suppliers of sugar in the world market, as their sugar production exceeds their sugar consumption.

3.1 Sugar production from sugar cane

The dominant role in production of sugar from sugar cane, but also in sugar production in general, is played by Brazil. This country currently produces around 40% of the world's sugar cane, grown on the area of 9.5 million hectares, and it accounts for 21.6% of the total world sugar production[7]. Here, one should bear in mind that a significant share of sugar cane in Brazil is used for ethanol production. Depending on trends in ethanol price (i.e. oil prices) and sugar, the Brazilian sugar industry changes the proportion of sugar cane used for ethanol production or sugar production.

Table 2 Key production figures – Brazil

Brazil	**Marketing year**	
	2012/2013	**2013/2014**
Sugar cane production (mil. tons)	532	597
Sugar cane used for production of:		
Sugar	**49.54%**	**45.22%**
Ethanol	**50.46%**	**54.78%**
Produced sugar (mil. tons)	34.10	34.30
Produced ethanol (billion litres)	21.36	25.58
Yield (litre of ethanol/ton of sugar cane)	79.57	78.18
Yield (kilo of sugar/ton of sugar cane)	129.38	94.72

Source: Unica, Final report of 2013/2014 harvest season[8]

Hypothetically speaking, if the total quantity of sugar cane had been processed into sugar, sugar production in Brazil in the marketing year 2013/2014 would have amounted to 56.55 million tons.

It should be kept in mind that only 70 million hectares of the total 850 million hectares in Brazil, or less than 9% of the total available area, is used for production purposes. In its projections of trends in sugar cane production, UNICA[9] envisages growth by the marketing year 2020/2021 to 1,200 million tons (double the current production level). Taking into account the usual ratio between sugar cane used for ethanol production (55%) and sugar cane used for sugar production (45%), this means that sugar production in Brazil, depending on trends in sugar cane yield and digestion (sugar content), should reach the level between 50 and 60 million tons per year. As it is expected in the same period that the world sugar consumption will grow by a total of 30 million tons, i.e. from the current 170 million tons to around 200 million tons, it is obvious that a good part of the expected production increase will be covered by Brazil. Depending on oil price trends, but also on investments in new processing capacities, the ratio of ethanol and sugar production in Brazil may vary to a significant extent and it will certainly have a key impact on the future situation in the global sugar market.

3.2 Sugar production from sugar beet

Sugar beet is grown in the northern hemisphere, on the area of around 5 million hectares, in areas with mild and moderate climate conditions. World sugar beet production is dominated by Europe, which accounts for more than 75% of the world production of sugar derived from sugar beet, and, observed by countries, by Russia, Ukraine, the USA, Germany, France, Turkey, China and Poland. In 2011 these eight countries accounted for 94% of the world sugar beet production.

To fully understand the market potential of the countries producing sugar from sugar beet, it should be pointed out that, except France, none of the countries have a significant sugar surplus in the market, which by no means reduces the importance of sugar quantities produced from sugar beet, because it is used to substitute import of sugar produced from sugar cane.

Table 3 World sugar-beet sugar production - 2011/2012

Country/Region	Planted area of sugar-beet		Sugar-beet sugar production		Tons of sugar / ha of the sugar-beet
	Ha	Share in the world area (%)	Tons	Share in the world production (%)	
EU - 27	1,540,000	30.4%	17,988,766	48.5%	**11.80**
Russia	1,210,000	23.9%	5,545,000	15.0%	4.58
Ukraine	532,000	10.5%	2,000,000	5.4%	3.76
Turkey	329,000	6.5%	2,300,000	6.2%	6.99
USA	450,000	8.9%	4,235,000	11.4%	9.41
Others	1,000,000	19.8%	5,000,000	13.5%	5.00
Total	**5,061,000**	**100.0%**	**37,068,766**	**100.0%**	**7.32**

Source: Food and Agriculture Organization of the United Nations (2012), According to: http://faostat.fao.org/site/339/default.aspx/ (Accessed on: February 24, 2015)

Information about sugar quantity produced per hectare from Table 3 also shows the competitiveness level in sugar production derived from sugar beet at the national level. The presented data indicate full domination of sugar beet producers from the EU-28 member states.

3.3 The sugar sector in the EU

As the Republic of Croatia became a full member of the European Union in July 2013, the Croatian sugar market also became part of the single European sugar market.

The production of sugar beet and sugar in the EU is regulated by sugar market orders[10], existing in various regulation forms and degrees since 1968[11]. Significant reforms have taken place on several occasions during that period. Among more recent ones is the reform adopted on 24 November 2005, referring to the period from 1 July 2006 to 30 September 2015. After negotiations with the World Trade Organisation (WTO) in Doha[12], the reform had the following results at the EU level:

- Removal of the intervention price of EUR 631.9 per ton of white sugar and introduction of the reference price, which had to be reduced by the marketing year 2009/2010 to the level of EUR 404 per ton of white sugar.
- Reduction of the minimum price for sugar beet from EUR 43.63 per ton to EUR 26.3 per ton by the marketing year 2009/2010.
- The current "A", "B" and "C" sugar production quotas were united in a single production quota, which initially amounted to 18.5 million tons of white sugar.
- As the sugar price in the European market was then significantly higher than the price of sugar which had preferential access to the EU market since 1 July 2009 as a result of Doha negotiations (mostly raw sugar from Least Developed Countries (LDC) and African, Caribbean and Pacific Group of States (ACP)), a new production compensation for white sugar was introduced, used for funding the programme for reduction of sugar production in the EU. The Commission's estimates were that the annual sugar surplus at the EU level would amount to around 6 million tons and for this reason a stimulation programme was launched to reduce sugar production in the EU. The programme encompassed the period from the marketing year 2006/2007 to the marketing year 2009/2010. Its financial value was EUR 5.7 billion and it envisaged a compensation in the amount of EUR 750 per ton of white sugar in 2006/2007, gradually decreasing until 2009/2010, when the compensation amounted to EUR 520 per ton of white sugar for all sugar factories that closed down (and physically destroyed, dismantled) all their facilities. To compensate for the

negative impact on sugar beet producers, in May 2007 the Commission also introduced additional stimulation payments for sugar beet producers through the Single Payment Scheme.

In the end, the entire reform resulted in the reduction of processing capacities by 60%, achieved by closing down 83 sugar factories in the EU, reducing production quotas by 30% or 6 million tons of sugar per year, and establishing a production quota for white sugar derived from sugar beet in the EU-28 at the level of 13.5 million tons per year.

3.3.1 Sugar consumption in the EU-28

According to the official data provided by the relevant body of the European Commission[13], as of 30 September 2014, sugar consumption in the EU-28 in the past four years ranged between 18 and 19 million tons per year.

Of the total sugar consumption in the EU, industrial consumers account for 70%, whereas household consumers account for 30% of production.

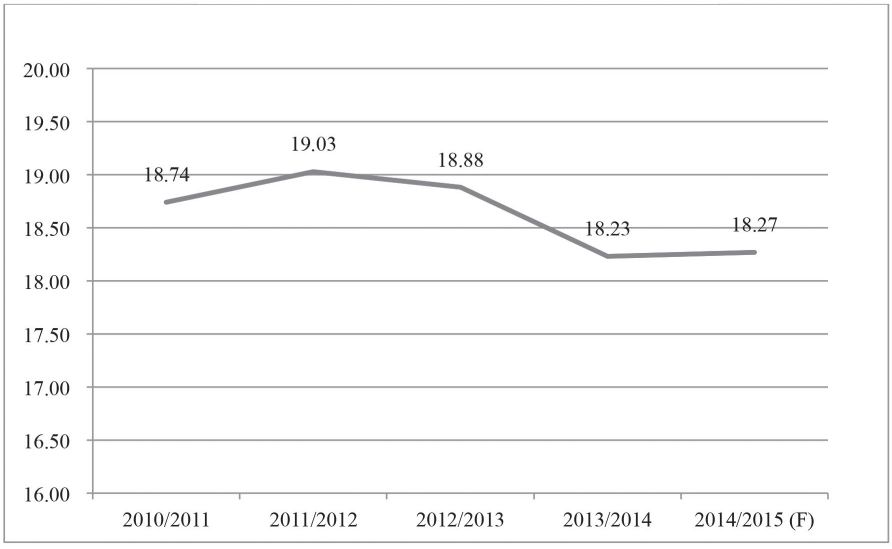
Observed by the origin of sweeteners, about 5% of the EU-28 needs are covered by isoglucose, 17% is sugar derived from sugar cane (through import of raw sugar) and the remaining 78% is sugar from sugar beet. According to FAO, sugar consumption in the EU is at the level of 39.13 kg per capita, which, taking into account imports and exports of products containing sugar, corresponds to the projections shown in Graph 4.

3.3.2 Sugar market supply in the EU-28

After the 2006 sugar market reform, in a very short period of time the EU-28 has gone from the second largest world exporter of sugar (after Brazil) to the second largest importer of sugar in the world (after Russia). The annual sugar import in the EU-28 is between 3-4 million tons per year, 90% of which is sugar, and 10% is sugar in processed products.

The structure of imported sugar in the marketing year 2013/2014 is dominated by sugar originating from ACP and LDC countries (over 70% of imported sugar), which is imported without any quantity or customs restrictions. The remaining raw sugar (from Brazil, Columbia, Peru) within so-called CXL quota is imported with import duty of EUR 98 per ton of raw sugar.

Graph 4 Sugar consumption in EU-28 (mil. t)



Source: Author

Table 4 Balance of sugar in EU-27 - 2012/2013 (000 t)

Description	Quota sugar	Out-of- quota sugar
Beginning stocks	1,595	
Production	14,597	
Sugar produced from sugar-beet	13,995	4,908
Transfer of out-of-quota sugar into quota sugar	602	(602)
Total import	4,158	
Sugar	3,635	
Processed goods	523	
Total available	**20,350**	**4,306**
Consumption	**16,575**	
Consumption - industry		**2,302**
Total Export	1,281	1,335
Sugar	63	
Processed goods	1,218	
Ending stocks	2,494	669
Total exit	**20,350**	**4,306**

Source: AGRI C5, European Commission, Sugar trade statistics, 10/2014

Any additional sugar quantity outside the TRQ system[14] can be imported to the single EU-28 market only with customs duties, which are EUR 339 per ton of raw sugar and EUR 419 per ton of white sugar, making sugar imported in this way entirely uncompetitive in the EU-28 market.

Table 4 shows that total sugar production from sugar beet at the EU-27 level in 2012/2013 amounted to 18,903,000 tons of sugar from sugar beet (13,995,000 tons/quota sugar + 4,908,000 tons/out-of-quota sugar). Total consumption was 18,877,000 tons of white sugar (16,575,000 tons + 2,302,000 tons) and it was covered by the beginning stocks of 1.6 million tons of sugar produced from sugar beet and the remaining 2.68 million tons were covered from processed raw sugar.

3.3.3 Production of sugar from sugar beet in the EU-28

As we have seen so far, the single EU-28 sugar market is predominantly (78%) covered by sugar produced from sugar beet in one of the nineteen EU-28 member states where sugar is produced from sugar beet. As the EU-28 was the second largest exporter of sugar in the world until the latest sugar market reform in 2006 and today it is the largest sugar importer in the world, along with Russia, the European Commission and the European Parliament decided to completely abolish production quotas for sugar produced from sugar beet within the EU-28, starting on 1 October 2017, and gradually allow liberalisation of sugar import and export. This fact is of particular importance for the Croatian sugar industry, which, after having entered the single EU-28 sugar market recently, will again face great market challenges in a few years. Its readiness for the challenges ahead will depend on a variety of circumstances, but in the end mostly on the competitiveness of the local sugar beet production.

Table 5 Sugar-beet sugar production in EU-28

Marketing year	Planted area of sugar-beet (ha)	Polarisation sugar (t/ha)	Quota production (tons of sugar-beet sugar)	Total production (tons of sugar-beet sugar/year)	Out-of-quota sugar-beet sugar (t/year)
2007/2008	1,722,000	10.3	13,336,741	15,836,930	2,500,189
2008/2009	1,474,000	10.8	13,336,741	15,236,909	1,900,168
2009/2010	1,535,000	11.7	13,336,741	17,505,338	4,168,597
2010/2011	1,519,000	10.3	13,336,741	15,429,140	2,092,399
2011/2012	1,524,000	11.8	13,336,741	18,743,490	5,406,749
2012/2013	1,497,000	11.3	13,336,741	17,366,485	4,029744
2013/2014	1,512,000	11.1	13,529,618	16,818,855	3,289,237
2014/2015 (F)	1,560,000	12.2	13,529,618	19,070,194	5,540,576

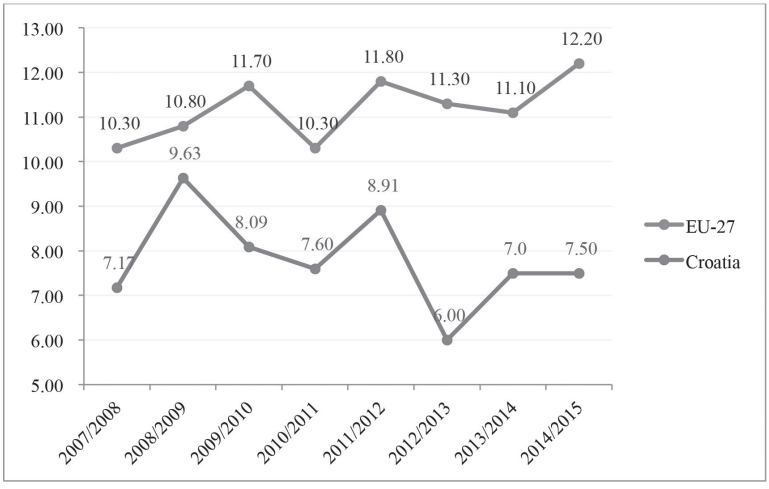
Source: Author

Within the EU-28, sugar derived from sugar beet is produced in nineteen member states according to the current production quotas, which, after Croatian accession to the EU, amount to 13,529,618 tons of white sugar from sugar beet15 and 720,441 tons of isoglucose per year. Sugar beet is grown on about 1.5 million hectares, which combined with the average production of 11-12 tons of sugar per hectare gives 17 million tons (the average in the past eight marketing years).

Therefore, although there are production restrictions, Table 5 shows that production of sugar from sugar beet in the EU-28 exceeded the production quota in each marketing year following the 2006 reform by an average of 3.6 million tons.

More detailed insight in the production of sugar from sugar beet is provided in Table 6, according to which the production of sugar from sugar beet in the EU-27 in the marketing year 2012/2013 was dominated (12 million tons) by five member states, namely France, Germany, Poland, Netherlands and the UK.

Graph 5 Sugar yield (tons/ha of sugar beet) in Croatia and EU-28



Source: Author

Table 6 Production of sugar-beet sugar in EU-27 - 2012/2013

Member state	Quota for sugar-beet sugar production (tons/ year)	Planted area of sugar-beet (000 ha)	Yield of sugar (tons/ha)	Total sugar-beet sugar production (tons)	Out-of-quota sugar produced (tons/year)
Belgium	676,235	63	12.1	761,533	85,298
Czech Republic	372,459	52	10.9	565,462	193,003
Denmark	372,383	41	11.7	480,366	107,983
Germany	2,898,256	350	11.4	4,006,872	1,108,616
Greece	158,702	9	5.9	158,126	-
Spain	498,480	36	14.8	531,845	33,365
France (Metropolitan)	3,004,811	341	12.4	4,222,847	1,218,036
France (DOM-Overseas)	432,220	-	-	412,164	-
Italy	508,379	52	10.5	546,362	37,983
Lithuania	90,252	19	7.6	190,253	100,001
Hungary	105,420	18	6.4	111,959	6,539
Netherlands	804,888	73	13.3	968,459	163,571
Austria	351,027	49	9.6	469,024	117,997
Poland	1,405,608	192	9.4	1,803,332	397,724
Portugal (Acores)	9,953	-	-	358	-
Romania	104,689	28	9.2	258,621	153,932
Slovakia	112,320	19	11.8	228,698	116,378
Finland	80,999	12	6.2	140,460	59,461
Sweden	293,186	38	9.6	365,869	72,683
United Kingdom	1,056,474	104	11.0	1,143,875	87,401
Total EU-27	**13,336,741**	**1.496**	**11.3**	**17.366.485**	**4.059.971**

Source: Author

The average sugar production per hectare in these five countries amounts to 11.6 tons, which is above the average level of the EU-27.

These five leading countries in the production of sugar from sugar beet are situated in the northern or north-western part of Europe, with favourable climate conditions for this crop. This primarily refers to extreme temperatures that are typical of the south-eastern Europe in July and August, when night temperatures often exceed 20 C°, causing sugar beet to stop growing and to start producing new leaves[16], resulting in the end in low sugar beet yield per hectare and low sugar content (digestion).

If sugar yields per hectare in the Republic of Croatia and the EU-28 are compared in the past eight years, significant deviations may be observed, which are extremely unfavourable for Croatian sugar beet producers in terms of their competitiveness.

The calculated eight-year average of sugar yield per hectare in the Republic of Croatia in the observed period is 7.80 tons per hectare, whereas in the EU-27 it is significantly higher, amounting to 11.19 tons per hectare, i.e. 43% higher than in the Republic of Croatia.

Consequently, the difference in sugar beet yield per hectare implies the difference in (lower) revenue per hectare between sugar beet producers in

Table 7 Cost calculation of sugar-beet production in Croatia – 2012/2013 (Case study: Agrotovarnik d.o.o. Tovarnik, Croatia)

Number	Cost	Unit cost -HRK/hectare of sugar-beet
1	Seed	1,456.75
2	Plant protection means	2,062.03
3	Fertiliser	2,457.30
4	Manure	1,291.79
5	Other materials	140.39
I=(1+2+3+4+5)	**Cost of materials**	**7,408.25**
6	Heavy tractor costs	709.24
7	Heavy tractor connected machine costs	97.45
8	Medium heavy tractor costs	586.75
9	Medium heavy tractor connected machine costs	154.86
10	Harvester costs	707.38
11 (6+7+8+9+10)	**Company machines costs**	**2,255.68**
12	**External machine services**	**394.57**
II = (11+12)	**Total machine costs**	**2,650.25**
13	Department overheads	1,201.40
14	Company overheads	1,218.82
III=(13+14)	**Total overheads**	**2,420.22**
15	Transport services	19.76
16	Samples control services	66.94
17	Land rent costs	541.95
18	Other costs	61.46
IV=(15+16+17+18)	**Total other costs**	**690.10**
19	Cost of permanent employees	533.12
20	Cost of temporary employees	694.55
V=(19+20)	**Total cost of workforce**	**1,227.66**
I+II+III+IV+V	**Total production costs**	**14,396.48**

Average yield of payable sugar-beet in Croatia, standard quality (16% sucrose content) in tons/ha	**48.74**

Total cost in HRK per ton of sugar-beet standard quality	**295.37**

Source: Author

the Republic of Croatia and the EU-27. To generate the same revenue per hectare, the sugar beet price for sugar beet producers in the Republic of Croatia should be 43% higher than the price for producers in the EU-27 or they should receive higher subsidies (additional payment for sugar beet). It is clear that the higher price of sugar beet for producers in the Republic of Croatia means higher price per ton of sugar produced by the Croatian sugar factories, which would deteriorate the sustainability

of this industry in the long run. Related to subsidies, additional payment for sugar beet will amount to EUR 6.5 million starting in 2015, which, based on the average area planted with 23,000 hectares of sugar beet in Croatia, presents additional payment in the amount of EUR 283 per hectare. Ten of the EU-28 states have additional payments for sugar beet and Croatia is in the eighth position by the amount of additional payments. A lower level of additional payments can only be found in the Czech Republic (EUR 267 per hectare) and Finland (EUR 70 per hectare).

The previously determined eight-year average yield per hectare of 7.80 tons in the Republic of Croatia, based on standard digestion of 16%, means the yield of (7.8t/16%=) 48.75 tons of payable sugar beet per hectare.

3.4 The break-even point in sugar beet production in the Republic of Croatia

In order to determine the competitiveness of the Croatian sugar beet production, costs of producing a ton of standard quality sugar beet should be determined first.

Although as a rule, costs of material or machine work are in direct correlation with the production volume and variable in their nature, in our example they are expressed as unit costs, because for the needs of this research they are observed at the level of one hectare, which is used as a basic production area.

In the above mentioned report[17], the reference price of sugar beet in 2020, i.e. after the new market order in the EU-28 becomes fully operational, is estimated at EUR 34 per ton of standard quality sugar beet (16% digestion) in the post quota sugar sector, starting from 1 October 2017.

By applying the midpoint exchange rate of the Croatian National Bank on 25 December 2014, the following result is obtained: EUR 34.00 x 7.661973= **HRK 260.51**, which would be the selling price of sugar beet.

To achieve a production cost coverage presented in Table 7, the required yield would be 55.26 tons of payable sugar beet of standard quality per hectare:

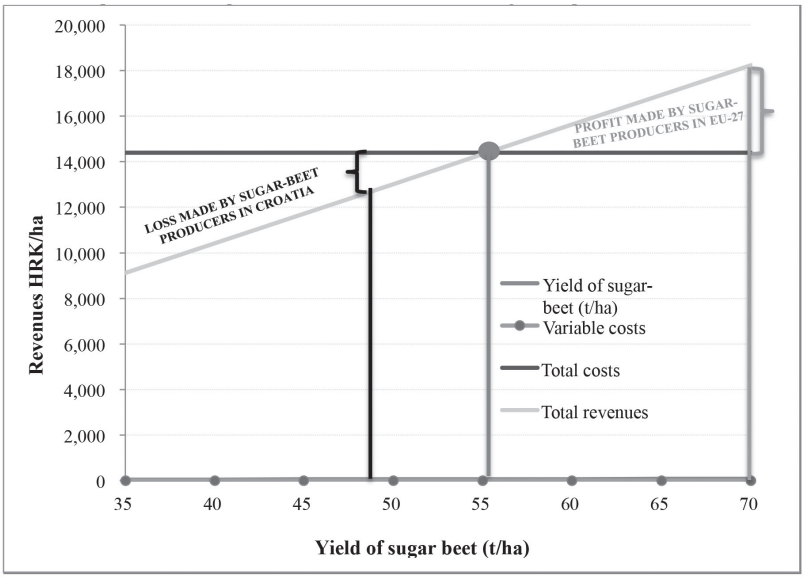
To obtain comparable data, it is presumed that there are no revenues from subsidies (regional payment and additional payment) and that production costs per hectare of sugar beet are the same as at the EU-28 level[18]. As shown in Graph 7, an average producer in the EU-28, with equal production costs, generates a profit amounting to HRK 3,787 per hectare of sugar beet. At the same time and under same conditions, an average sugar beet producer in the Republic of Croatia generates a loss of HRK 1,700 per hectare of sugar beet. The reason for such a big difference lies solely in the yield per hectare of sugar beet. Both producers implement all the required agrotechnical measures, they have similar labour and machinery costs, but in the end, due to different yields, they have completely different business results.

To assess the competitiveness of the Croatian sugar industry, we should certainly bear in mind the technological level of the Croatian sugar factories, but even more importantly their capacity, given that fixed costs (amortisation, full-time workers, CAPEX) account for about 50% of total costs. The average daily processing capacity of the Croatian sugar factories is around 6,330 tons per day per factory (Osijek 7,000 tons; Županja 6,000 tons; and Virovitica 6,000 tons), with average campaign duration being 90 days, which means that in a usual average 90-day campaign the Croatian sugar factories process around 1.7 million tons of sugar beet per year.

The average capacity in the remaining EU-28 states (106 sugar factories) is 9,143 tons of sugar beet per day per factory, or overall 941,697 tons of sugar beet per day, with average campaign duration being 120 days. The total quantity of sugar beet bought by sugar factories in the EU-27 was around 100 million tons in the past few years, whereas the average quantity of sugar beet in the EU-25 before the last sugar market reform in 2006 amounted to 127 million tons per year.

$$TP(kp) = \frac{295.37}{260.51} = 1.133826\ x\ 48.74 = 55.26\ tons\ of\ sugar\ beet/ha$$

Graph 6 Break-even point measured in volume (tons) of sugar-beet per hectare in Croatia



Source: Author

4. Conclusion

Sugar beet has a dominant role in the cost price of a ton of white sugar. Available calculations of the major sugar producers in the EU-28 (Table 6) show that the cost of sugar beet processing amounts to EUR 150 per ton of white sugar, and the share of sugar beet in a ton of sugar is calculated based on 86% utilisation, which means that a ton of white sugar requires (1,000kg/(16% digestion x 86% utilisation) = 7.267 tons of standard quality sugar beet. If the forecasted price of sugar beet is EUR 34 per ton, this means that the participation of sugar beet in a ton of white sugar is (7.267 tons of sugar beet x EUR 34 per ton) EUR 247, i.e. around 62% of total costs (EUR 150+EUR 247=EUR 397 per ton) of white sugar production.

According to the conducted research, it can be concluded that sugar production per hectare in the Republic of Croatia is lower (-43%) in comparison to the remaining members of the EU-28, as are the installed daily processing capacities per sugar factory per day (-44%). With the average yield being 7.8 sugar per hectare and without subsidies, Croatian sugar beet producers generate loss in this production segment (the break-even point expressed as the quantity of products is at the level of 55.26 tons of sugar beet of standard quality per hectare) and, consequently, they produce only 1.12 million tons of sugar beet, which is sufficient for all Croatian sugar factories to work only 59 days in a year. All this greatly increases the costs of sugar production and makes the Croatian industry in its current form vulnerable and even unsustainable in the long run, particularly after 1 October 2017.

Additional payment per hectare based on the envelope amounting to EUR 6.5 million per year, which comes into force with the marketing year 2015/2016, will not influence the competitiveness of the Croatian sugar beet production to a more significant level by itself. On the contrary, as the current price of white sugar in the single EU-28 market is below EUR 400 per ton, and with this year's expected production in the EU-28 amounting to extremely high 19 million tons of sugar derived from sugar beet, the price of sugar beet in the following few years will probably have to be lower than the forecasted EUR 34 per ton. Given that the current additional payment per hectare of sugar beet is around EUR 180, and the average area under sugar beet in Croatia in the past few years has been 23,000 hectares, at the price of EUR 40 per ton of payable sugar beet, standard quality, it is quite realistic to assume that the decrease in the price of sugar beet will result in a reduction of areas planted with sugar beet in the Republic of Croatia, which are insufficient as it is.

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(Endnotes)

1 Common Agricultural Policy – CAP.

2 Single Common Market Organisation for Sugar (CMO Sugar).

3 Stabilisation and Association Agreement, Official Gazette – International Treaties No. 14, 27 December 2001, which came into force on 1 February 2005.

4 According to the Croatian Chamber of Economy, Sector for Agriculture, Food Industry and Forestry, exports of the sugar industry in 2011 amounted to 185 million USD, or nearly 20% of total exports in this sector.

5 Joint Research Centre Institute for Prospective Technological Studies; EU sugar policy: A sweet transition after 2015?

6 OECD and FAO Secretariats; http://www.oecd.org/site/oecd-faoagriculturaloutlook/sugar.htm/(January, 2015).

7 According to: http://www.unicadata.com.br/ (January, 2015).

8 Ibid.

9 Brazilian sugarcane industry association.

10 Common Market Organization for Sugar.

11 European Sugar Sector, 2005., Mariann Fischer Boel, Commissioner for Agriculture and Rural Development.

12 9th Round of multilateral trade negotiations, launched in November 2001, in Doha, Quatar, at the WTO's Fourth WTO Ministerial Conference.

13 Committee for the common organisation of agricultural markets.

14 During the WTO's Uruguay Round, members agreed to a tariff rate quota (TRQ) system as the most appropriate method to ensure market access during the transition from an agricultural trading system of complex tariffs and nontariff barriers to a tariffonly regime.

15 The annual production quota for Croatia of 192,877 tons of white sugar derived from sugar beet should be added to the quotas shown in Table 6.

16 According to: http//www.kws.de/aw/KWS/serbia-montenegro/_e_erna_rfb/Bolesti_secerne_repe/~dcvn/ Cercospora_ Beticola/undefined/ (January, 2015).

17 See endnote 1.

18 The cost structure in sugar beet production is such (a large proportion of the costs is incurred by plant protection materials, fertilizers and machinery) that given the single economic area, there is not much variation in the prices of these inputs, and thus also not in sugar beet production costs at the EU-28 level.

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Ilija Nedić

Točka pokrića u proizvodnji šećerne repe

Sažetak

Potrošnja šećera u svijetu u zadnjih 70-ak godina bilježi stabilan rast koji će se po svim relevantnim procjenama nastaviti i u sljedećem desetljeću, a što svrstava šećer u kategoriju najznačajnijih prehrambenih i burzovnih roba na svijetu.

Od ukupne svjetske proizvodnje šećera oko 77% čini šećer proizveden iz šećerne trske, a 23% šećer proizveden iz šećerne repe. Vodeće mjesto u svjetskoj proizvodnji šećera, već duže vrijeme drži Brazil s proizvodnjom bijeloga šećera proizvedenoga isključivo iz šećerne trske, dok među proizvođačima šećera iz šećerne repe, vodeće mjesto u svijetu drži EU-28.

Kako je domaća industrija šećera od ulaska Republike Hrvatske u EU dio jedinstvenoga europskoga tržišta šećera, u istraživanju se primjenom Metode točke pokrića utvrdila razina konkurentnosti domaće proizvodnje šećerne repe.

Na bazi očekivane prodajne cijene za šećernu repu od 34 EUR/t šećerne repe standardne kakvoće primjenom Metode točke pokrića, utvrđeno je da potrebna količina za pokriće ukupnih troškova u prozvodnji šećerne repe u Republici Hrvatskoj iznosi 55,26 tone/ha plative šećerne repe, standardne kakvoće, odnosno 8,84 tone polarizacijskog šećera po hektaru. S obzirom da prosječna proizvodnja šećerne repe u RH iskazana u ekvivalentu polarizacijskoga šećera iznosi 7,8 t/ha jasno je da prosječni domaći proizvođač šećerne repe, bez prihoda od poticaja, ostvaruje gubitak u ovoj proizvodnji.

Ključne riječi: točka pokrića, šećer, repa, trska